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DM42A

KEITHLEY INSTRUMENTS, INC.

PRECISION Standards CORP.
1701 REYNOLDS, SANTA ANA, CALIF. 92705

DIGITAL MULTIMETER

MODEL DM 42A

SERIAL NUMBER_____

SECTION I

INTRODUCTION

1.1 The Precision Standards Corporation Model DM 42A Digital Multimeter is a low cost, portable, highly accurate instrument. This instrument is capable of measuring DC volts in five ranges, AC volts in four ranges and ohms in six ranges. Other features of the DM 42A includes; input guarding, auto-polarity, four digit readout with overrange "1", variable sampling and pushbutton function and range selection.

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SECTION I

SPECIFICATIONS
DM-42

DC VOLTS

ACCURACY: (20°C to 30°C, 90 day calibration cycle)	±(0.02% of reading +0.01% of range) 1,10,100,1000 V ranges ±(0.02% of reading +0.02% of range) 100mv range. * ±(0.02% of reading +0.05% of range) 10 mv range (option). *
(15°C to 35°C, 6 month calibration cycle.)	±(0.03% of reading +0.01% of range) 1,10,100,1000 V ranges ±(0.03% of reading +0.02% of range) 100 mv range. * ±(0.03% of reading +0.05% of range) 10 mv range (option). * * Exclusive of zero drift, typically 5 microvolts/°C
RANGES:	10mv (option), 100mv, 1 V, 10 V, 100 V and 1000 volts DC, 100% overranging to maximum of 1200 volts DC, automatic polarity indication.
RESOLUTION:	10 microvolts, 1 microvolt with 10 mv range option.
INPUT RESISTANCE:	100 megohms on the 10 mv, 100 mv and 1 volt ranges. 10 megohms on the 10 V, 100V and 1000 volt ranges.
OVERLOAD:	Up to 1200 volts AC or DC on any DC range without damage.
SPEED:	5 readings per second with variable sample rate, filter out.
NORMAL MODE REJECTION:	60 db at 60 Hz with filter in.
COMMON MODE REJECTION:	100 db DC to 60 Hz, filter in.
WARM-UP TIME:	Operational Immediately, to rated accuracy - 30 minutes all functions.

AC VOLTS

ACCURACY:	±(0.2% of reading +0.05% of range). 50 Hz to 10 kHz, 15°C to +35°C, 6 month calubration cycle.

±(0.5% of reading +0.1% of range). 30 Hz to 20 kHz, 15°C, 6 month calibration cycle.

RANGES: 1V, 10V, 100V, 1000V, 100% over-ranging on all ranges to a maximum of 1100 volts rms.

RESOLUTION: 100 microvolts.

INPUT IMPEDANCE: 1 megohm + 40 pF.

OVERLOAD: Up to 1200 volts AC or DC on any AC range.

SPEED: 3 seconds, filter out.

K OHMS

ACCURACY: ±(0.05% of reading +0.02% of range) 1 K range to 1000 K range + 20°C to 30°C, 90 day calibration cycle.

±(0.1% of reading +0.02% of range) on all ranges, +15°C to + 35°C, 6 month calibration cycle.

RANGES: 0.1K, 1K, 10K, 100K, 1000K and 10 megohms with 100% overranging on all ranges.

VOLTAGES ACROSS UNKNOWN: 5 volts at full scale on all ranges except .5 volts on 1K range.

RESOLUTION: 0.01 ohms.

OVERLOAD: Up to 20 volts AC or DC on .1K and 1K ranges, 200 AC or DC volts on all other ranges.

SPEED: 500 ms on all ranges except maximum of 3 seconds on 10 megohm range, filter out.

CURRENT THROUGH THE UNKNOWN: 5ma 100 and 1K ranges, .5ma 10K range, .05 ma 100K range, .005ma, 1M and 10M ranges.

GENERAL:

ACCESSORIES:

A. Printer output (BCD - TTL compatible with negative true logic).

B. 10 mv input amplifier (10 mv dc full scale range) 3 second response time.

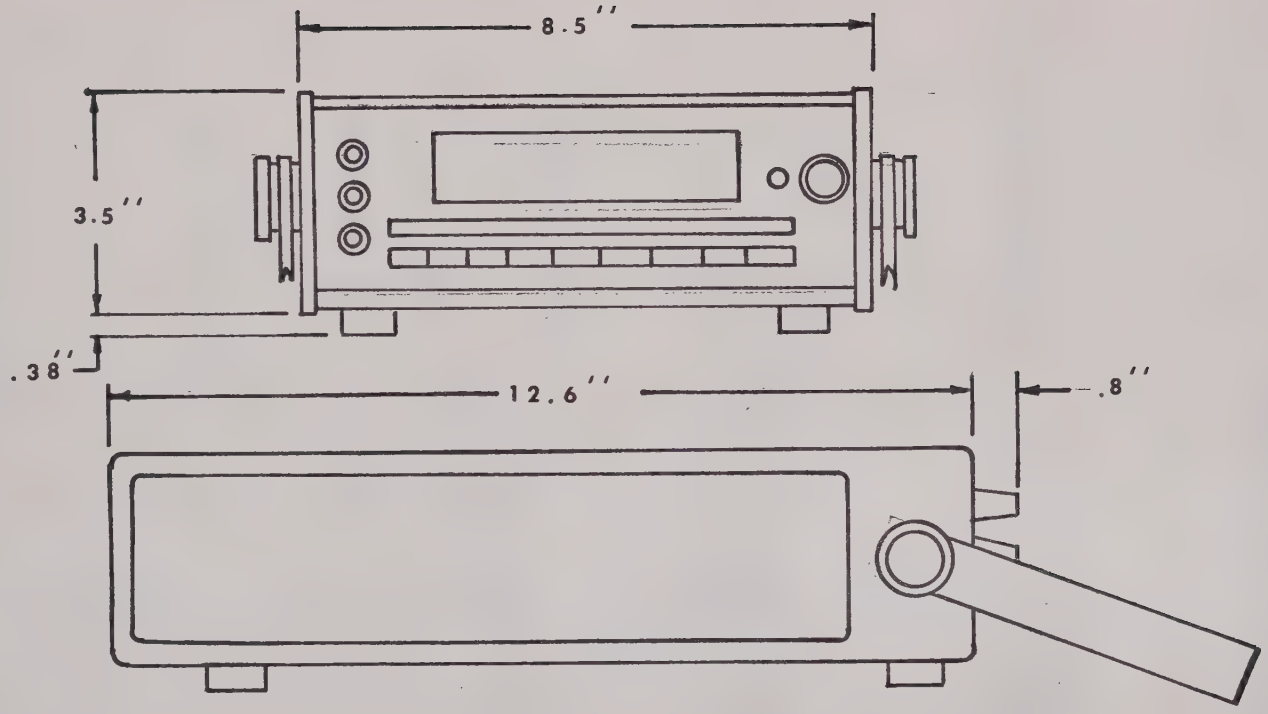


FIG. I-1

PRECISION STANDARDS CORP.

SCALE:	APPROVED BY:	DRAWN BY
DATE:		REVISED

OUTLINE DRAWING DM42 and DM 55

DRAWING NUMBER

SECTION II

OPERATING INSTRUCTIONS

2.1 Controls, Terminals and Indicators

Front Panel:

INPUT TERMINALS	Connection for all unknown AC volts, DC volts, and resistance measurements.
GUARD TERMINAL	Connection to internal guard shield provides increased common mode rejection. Normally, connected to the low input terminal, it may also be driven by a seperate guard potential up to 100 VDC.
FUNCTION SWITCHES	Four pushbutton switches select the desired input mode: DC volts, AC volts, kilohms, and 10 megohms. (Note that depression of the 10M function interlocks Kohms, both buttons must be depressed with all Range Buttons Out for 10M operation.)
RANGE SWITCHES	Five pushbutton switches select full scale ranges for volts and resistance measurement.
FILTER SWITCH	In the "on" position, provides increased normal and common mode rejection for noisy or unstable sources. It should be noted that use of the filter will also decrease response time.
POWER/RATE	In the full CCW position the power is off. CW rotation energizes AC power, and increases the rate at which measurement readings are displayed. (Measurement display is variable from 1 reading/2 seconds, to 5 readings/second.)
READOUT INDICATORS	Provides five digits of readout, (with OR "1"), minus polarity sign, and "out of range" indication.

PRINT PUSHBUTTON	When activated, provides print command to J2 print output connector and a hold on the digital section of the DM 42.
M.V. ZERO	Provides means to zero reading when in the 100 MV DC range.

Rear Panel:

AC LINE CORD	Three wire line cord for connection to 115/230 VAC, 50 hz - 440 hz.
FUSE	Provides power input protection for 115 VAC operation fuse 1A, for 230 VAC operation fuse 1/2A.
J2 PRINT CONNECTER	An integral part of the digital assembly, these connections provide parallel information of display, range, and function with installation of the Print Output Option. For connector information see Page 2-5.

2.2 DC VOLTAGE MEASUREMENTS

The Model DM 42 will measure DC volts in five ranges from 100 MV full scale to 1000V full scale. 100% overrange measurement capability is provided in all but the 1000V range where 20% overrange is available. Program for DC voltmeter capabilities as follows:

Function:	DC
Range:	Select from .1, 1, 10, 100, 1000V full scale ranges.
Filter:	If increased noise rejection is desired, switch to filter "on" position.
Input Terminals:	Connect the voltage to be measured to the input terminals. If the guard terminal is not externally driven, short to the low input terminal.

2.3 AC VOLTAGE MEASUREMENTS

The Model DM 42 will measure AC voltages with frequencies of 30hz to 20khz, from 0V to 1000V full scale in four ranges. 100% overrange measurement capability is provided in all but the 1000V range, where 20% overrange is available. Program for AC voltmeter capabilities as follows:

Function:	AC
Range:	Select from 1, 10, 100, 1000V full scale ranges.
Filter:	If increased noise rejection is desired, switch filter to the "on" position.
Input Terminals:	Connect the voltage to be measured to the input terminals. If the source low terminal is grounded tie this terminal to input low. If the guard is not driven externally, short to the low input terminal.

2.4 RESISTANCE MEASUREMENTS

The Model DM 42 will measure resistance from 0 ohms to 10 megohms in six full scale ranges. 100% overrange capability is available on all ranges. Program for Ohmmeter capabilities as follows:

For 100 ohms to 1 M ohms full scale ranges

Function:	K ohms
Range:	.1, 1, 10, 100, 1000
Input Terminals:	Connect the unknown resistance between the input terminals, tie the guard terminal to the low input terminal.

For 10 megohm full scale range

Function:	10M, Note: that depression of 10M function also depresses Kohm function.
Range:	All other range switches must be out.
Input Terminals:	Connect the unknown resistance between the input terminals, tie low to guard terminal.

NOTE!

Low resistance, (less than 10 milliohms), connections should be maintained for optimum performance. Shielding on higher ranges will reduce noise and offset.

CAUTION

Guard against applying voltage on the ohmmeter function!

2.5 GUARD TERMINAL

The DM 42 input circuitry is floating from earth ground to provide isolation. For greater isolation, and to lower errors due to common mode currents, the inner shield is terminated at the front panel guard terminal. Under normal circumstance the guard terminal should be tied to the low input terminal, however, it may be driven by an external guard voltage up to 100V or peak AC.

2.6 OVERLOAD PROTECTION

The DM 42 is protected against overload in all functions and ranges. In AC and DC voltage modes up to 1200V may be applied without damage. In the 100 ohms ranges will withstand up to 200V. As an added precaution the "Out of Range" indicator will blink when voltages or resistance greater than 100% overrange are applied to the input terminals. As a matter of good practice, it is not recommended that voltage be applied to any ohm range.

2.7 PRINT OUTPUT OPTION

A. DTL, TTL Compatible print information is available as an option on the DM 42. The print output connector, J2, is an intregral part of the Digital and Power Supply assembly.

B. Specifications:
Print output is BCD 1248, common true. Logic is compatible with DTL, TTL, maximum sink current 1 ma.

C. Interface, pin function information a mating connector, P2, is supplied with the print output. Install this connector such that Pin 1 is in the upper left corner. Following is the wiring list and pin function information when P2 is installed as stated above.

CAUTION!

Shorting print output pins may result in damage to the DM 42. Use Care.

D. Interface Information

P2 MATING CONNECTOR	OUTPUT INFORMATION	DESCRIPTION
Pin 1	Not Used	
Pin 2	Not Used	
Pin 3	Not Used	
Pin 4	Not Used	
Pin 5	Not Used	
Pin 6	Range 2	Decimal Point X.XXXX
Pin 7	Range 3	Decimal Point XX.XXX
Pin 8	Range 4	Decimal Point XXX.XX

Interface Information (con't)

P2 MATING CONNECTOR	OUTPUT INFORMATION	DESCRIPTION
Pin 9	Range 5	Decimal Point XXXX.X
Pin 10	Units 4 bit	Least significant Decade 4
Pin 11	Units 8 bit	Least Significant Decade 8
Pin 12	Units 2 bit	Least Significant Decade 2
Pin 13	Units 1 bit	Least Significant Decade 1
Pin 14	Tens 8 bit	BCD 4
Pin 15	Tens 4 bit	BCD 8
Pin 16	Tens 2 bit	BCD 2
Pin 17	Tens 1 bit	BCD 1
Pin 18	Not Used	
Pin A	Not Used	
Pin B	Not Used	
Pin C	Not Used	
Pin D	Function 1	AC Mode
Pin E	Function 2	10M Mode
Pin F	Function 3	K ohms Mode
Pin H	P. C.	Pint Command Out
Pin J	10K - 1bit	O. R. "1"
Pin K	Minus	Minus Polarity
Pin L	100's 8 bit	BCD 8
Pin M	100's 4 bit	BCD 4
Pin N	100's 2 bit	BCD 2
Pin P	100's 1 bit	BCD 1
Pin R	100's 8 bit	BCD 8
Pin S	1,000 4 bit	BCD 4
Pin T	1,000 2 bit	BCD 2
Pin U	1,000 1 bit	BCD 1
Pin V	Digital Common	Common Reference for all print outputs

E. Print Command

Actuating the print button on the front panel results in; 1. Lock-up of all digital counters through Z1a for approximately 60 M.S. 2. Creation of a print command through Z2a which is AC coupled to P2 print output connector through C32. The print command is approximately 15V P-P, by 1ms wide.

SECTION III

THEORY OF OPERATION

3.1 GENERAL DESCRIPTION:

The Precision Standards Corp. model DM42 Digital Multimeter utilizes a modified integrating technique for A/D conversion. This conversion may be broken into two major areas: Analog and Digital.

The Analog section provides input signal conditioning, attenuation, filtering, buffering, comparing and initiates the main control signal for the entire system. The digital section provides logic control, counting, decoding and display and also located on the digital assembly are the power supplies for the entire system. Both sections make up a closed loop system completely dependent upon the other for proper operation. Following is a general block diagram description of functions within the system. (Refer to figure 3-1 system block diagram.)

To follow through a block diagram description it will be necessary to establish a starting point making several assumptions: Assume the display to be reading 0000, the counters have all been re-set to zero, the analog switch has just turned on, that is; the integrator is sampling the voltage at the input terminals. A voltage of +5VDC has been applied to the input terminals. The 5VDC signal is routed through the DC attenuator, this signal applied on the 10VDC range would be attenuated to .5VDC and routed through the input filter where any AC component would bypass to common. The output of the filter section is applied

to the Input Amplifier which provides input signal isolation, buffering and a gain factor of X10 on the 10VDC range. The amplified signal, now at +5VDC, is applied to the Integrating Amplifier via S1 Analog Switch. The Analog Switch has been turned on by a control level provided by circuitry in the digital section. This control allows the integrating capacitor, C1, to charge for a fixed period of time, approximately 100 milliseconds, or 20,000 counts. The final count pulse clears the counter to 0000. At the end of this period of time a combination of a logic level at the output of the Zero Detector Amplifier and resetting of the primary switch control flip-flop causes S1, Analog Switch, to turn off and S3, Minus Reference Switch, to turn on. The counter begins counting towards full scale again. With a minus input on the Integrating Amplifier, C1 begins to discharge towards zero. Upon reaching zero volts, the zero detector creates a logic pulse. The counter has counted to 5.000. This pulse becomes a primary control for the logic. It is gated with the Display Control, (rate), which strobes the Storage section. Information present in Storage is now available to the Decoders which decodes and furnishes logic levels to light the display with the counted number, 5.000. Immediately following the Strobe is another pulse created from the zero detector pulse which resets all counters to zero and re-sets the Switch Control Flip-Flop. This causes S3, Minus Reference Switch, to turn off, and S1 Analog Switch to turn on.

The system is now ready to begin another sequence. The display will remain at 5.000 until receipt of another zero detector pulse.

3.2 DETAILED DESCRIPTION ANALOG ASSEMBLY.

The following paragraphs describe individual Analog circuits in detail. These circuits are divided according to their primary function in the system. (Refer to schematic 338-100-80.)

A. DC ATTENUATOR

A 10 megohm divider using R1-7, and parts of S2, S5-9, provides attenuation for input signals above 2VDC, (100% overrange on the 1V range). S5E and S6D are used to short out the high impedance for better input matching on the lower two ranges.

B. INPUT FILTER

This section provides attenuation of AC components and noise present on DC input signals. Additional filtering may be obtained by a front panel switch, S10, which programs C5 into the circuit. This circuit allows maximum filtering at a minimum speed.

C. INPUT AMPLIFIER

Comprised of three active components, this circuit provides input isolation and signal conditioning. Q6 is a low leakage matched FET providing high input impedance and matched voltage and temperature tracking. A bipolar device, outputs from this FET are applied directly to A1 an operational amplifier. The S.O.T. resistors are selected for zero output with the input shorted on the 1VDC range, while Q7 provides a constant current source. A1, and I.C. Operational Amplifier, provides the gain required by the Integrating Amplifier. On the .1V range S5D selects resistors for a DC gain of 50, all other ranges program the gain to 5. S1C

and S5C close to provide offset voltage necessary for zeroing the .1VDC range. The maximum output swing at the Input Amplifier TP1 is ±10VDC. This output is fed directly to Q17, the Analog Switch, in all but the 100 Ohm range.

D. S1, 2, 3 SIGNAL SWITCHES (See Fig. 3-1)

Comprised of Q15, 16, and 17, these solid state switches provide high speed, low leakage paths for signals applied to the Integrating Amplifier. These switches are driven by logic levels from the Digital Assembly with Q8 through 13 supplying buffering.

E. INTEGRATING AMPLIFIER

Also a biploar circuit this Amplifier integrates DC levels from signals applied through S1, 2, and 3. A unity DC gain amplifier, the precision ramps created by the time constants of R92 and C33 are directly proportional to the clock speed in the digital section. Using a modified dual slope principal, the charge time of C33 is fixed at approximately 100ms, while the discharge time is a function of the input voltage. The maximum swing at the output of this amplifier, TP4, is approximatly -12V peak. The output is fed directly to the comparator.

F. COMPARATOR - ZERO DETECTOR

This circuit creates the main control pulse and logic level necessary for proper digital and analog functions. A4, an I.C. operational amplifier, provides a DC gain of approximately 5 for signals received from the Integrating Amplifier. A5, the zero Detecting Amplifier will trigger on signals less than +1mv. The level at the output of A5 is determined by the polarity of the unknown input signal. A plus input signal will create a high logic level +5V, while a minus unknown will create a low, 0V. A pulse, whose width is determined by the resetting of the main control flip-flop will be present when the Integrating Amplifier crosses zero. The output level of this circuit is limited by CR2, a 5V zener diode. The output level is used to determine polarity, while the pulse at zero detection creates strobe and re-set commands for the digital section.

G. A.C. CONVERTER SECTION (Fig. 3-4)

A.C. voltage measurements applied to the input terminals are converted to d.c. levels via this converter amplifier. Input signals are attenuated and applied to Q1, the input F.E.T. This three stage, high input impedance, AC amplifier converts AC RMS signals to DC voltages directly proportional. The maximum output swing is plus 2VDC, (100% overrange). DC signals at the output TP6, are fed directly to the Input Amplifier via the Input filter.

H. OHMS CONVERTER SECTION (Fig. 3-3)

Resistance measurements applied at the input are converted to DC voltages in this section. Utilizing the Input Amplifier, and a precision constant current source, the voltage drop across the unknown resistor is measured as a DC voltage. Scale factor resistors are switched via the front panel. Maximum output at TP1 is +10VDC on all but the 100 Ohm range where it is +1VDC. A X10 gain Amplifier, A2, increases the voltage to +10VDC on this range to a proper level for use by the Integrating Amplifier.

3.3 DETAILED DESCRIPTION DIGITAL SECTION

The following paragraphs describe individual circuits located on the Digital Assembly in detail, according to their primary function in the system. (Refer to Schematic 338-314-81)

A. SYSTEM POWER SUPPLIES

Four basic DC Power Supplies are created on this assembly for use in the entire system. A step-down, dual primary transformer supplies AC power to three separate rectifiers. Raw DC supplies are then applied to the individual regulator circuits, creating well regulated current limiting DC voltages. The +5V supply is used as VCC for all digital IC's. The +15V and -15V supplies are provided as operating voltages for all linear IC's. The +170V unregulated supply is the voltage used at the neon indicator tubes.

B. MASTER CLOCK

A free running multivibrator, this circuit creates clock pulses used by the counters. A single dual power inverter and two capacitors, create these pulses with C9 for repetition rate, and C10 for pulse width. The frequency of this clock is approximately 200 Khz.

C. THE COUNTERS

These 1248 Binary counters create logiv information necessary for lighting the numbers in the individual decades. Starting at the least significant decade, clock pulses set the counters in sequence. Each Counter divides the clock by a factor of 10. The final output flip-flop, Z11A, is running at 20 times per second or a 50ms rate. This rate in turn is fed into another divide by 2 flip-flop, the primary switch control flip-flop Z3A, which determines the basic digitizing rate of the DMM. It should be noted that a full set- reset cycle at Z3A completes 1 digitizing time, thus 5 readings per second. These counters are re-set to zero via an output at Z4 when Z3A is re-set by the final counter Z11A.

D. STORAGE AND DECODING

OUtputs from the counters are stored in the bi-stable latches Z12 through Z15 and flip-flop Z11B. This stored information is transferred to the inputs of the decoders upon receipt of a strobe pulse created by the zero detector through Z3A, Z5, Z21 and Z22. The Decoders decode the 1248 Binary information to decimal, creating the logic common necessary to light the neon indicators.

E. POLARITY AND OUT-OF-RANGE

Z1B used as a storage flip-flop is set by the strobe pulse for polarity information. An edge created by the zero detector level through Z2 sets Z1A. The Set and re-set outputs of Z1A "anded" with the primary switch control flip-flop determines which reference switch will be turned on. The true state for this control, whose outputs are at Z2 pins 6 and 8, is common. These outputs control S2 and 3 polarity switches, while the output of Z3A controls S1 Analog Switch. The

Out-Of-Range indicator will turn off and on at the counter rate when the counter has counted to full scale and a strobe pulse has not been received.

F. RATE CONTROL

The display rate of the DMM is controlled via a free running oscillator gated through Z10. This control does not interrupt the digitizing rate, only the rate at which the counted information is strobe to the decoders for display. The free running unijunction oscillator furnishes a set pulse variable from a repetition rate of 1/2 seconds to 5/second. This pulse sets the flip-flop at Z10 which gated to Z21 pin 1, enables this gate allowing the strobe pulse through. Approximately 10 micro-seconds following the strobe, a pulse re-sets the flip-flop at Z10 disabling the gate at Z21. This gate can only be enables by another pulse from the rate oscillator.

SECTION IV

CALIBRATION PROCEDURE

4.1 Required Calibration Equipment

A. Precision differential V.M., PSC Model DC200C or equivalent.

B. Precision D.C. Voltage standard, PSC Model 460B or equivalent.

C. An A.C. standard with an output 0 to 1000 VAC 30 hz to 20 Khz and an accuracy better than 0.2%.

D. A set of precision wire-wound resistors with an accuracy better than 0.02%. Values should be 10 ohms, 100 ohms, 1K ohms, 10K ohms, 100K ohms, 1M ohms and 10M ohms.

NOTE:

Do not move any internal adjustments until the need has been established. Inadvertant movement of the adjustments can lead to extensive and unnecessary calibration.

4.2 Calibration Sequence

It is recommended that the following sequence be used:

Allow 30 minute warm-up time prior to calibration.

All readings are in reference to input low unless otherwise specified. For adjust location refer to Fig. (4-1)

4.3 Input amplifier zero, readout zero

The input amplifier zero is a factory adjustment. Zeroing on the 100MV range to compensate for drift due to temperature may be accomplished via the front panel "MV Zero".

4.4 Comparator zero

A. Program:

Function	-DC
Range	-1
Input Terminals & Guard	-shorted

B. Monitoring the DM 42A Display, adjust R94 for 0.000. Program the remaining four ranges and verfy the reading to be zero ± 1 digit on all ranges.

4.5 Reference Adjustment

A. Program:

Function	-DC
Range	-1
Input Terminals & Guard	-shorted

B. Monitoring the output of the positive reference, TP2 Adjust R77 for a reading of +10V ±100 microvolts.

C. Monitoring the output of the negative reference, TP3 adjust R75 for a reading of -10V ±100 microvolts.

4.6 DC Range Calibration

A. Program:

Range	-.1
Function	-DC
Filter	-On

B. Short the input and zero the readout using "MV Zero".

C. Using a DC Calibrator apply +100mv to the input terminals short low to guard. Adjust R61, 100 mv gain adjust for a reading of 100.00. Reverse the polarity and verfy a reading of - 100.00 ± 4 digits.

D. Program: Range -1
Apply + 1V to the input terminals. Adjust R 59 1V gain adjust, for a reading of 1.0000.

E. Program: Range -10
Apply + 10V to the input terminals. Adjust R3 for a reading of 10.000.

F. Program: Range -100
Apply + 100V to the input terminals. Adjust R5 for a reading of 100.00.

G. Program: Range -1000
Apply + 1000V to the input terminals. Adjust R7 for a reading of 1000.0.

4.7 AC Range Calibration

Program:

Function	-AC
Range	-1
Filter	-On

A. Using the AC Standard, apply 1VAC, 400 hz, to the input terminals, (ground to low input with guard tied to low). Adjust R40 low frequency adjust for a reading of 1.0000. Apply 1 VAC 10Khz, adjust C14 high frequency adjust for a reading of 1.0000. Apply 1 VAC at 30hz, 5Khz, and 20Khz, verifications of specifications at these frequencies will substantiate linearity of the converter.

B. Program: Range -10
Apply 10 VAC, 400hz, adjust R14, low frequency adjust, for a reading of 10.000. Apply 10 VAC, 10Khz, adjust C7, high frequency adjust for a reading of 10.000. Verify specification at 10 VAC 30 hz, 5Khz, and 20Khz.

C. Program: Range -100
Apply 10 VAC, 400 hz, adjust R17, low frequency adjust, for a reading of 100.00. Apply 100V, 10Khz, adjust C9 for a reading of 100.00. Verify specification at 100 VAC, 30hz, 5Khz, and 20Khz.

D. Program: Range -1000
Apply 1000VAC, 400hz, adjust R20, low frequency adjust, for a reading of 1000.0. Apply 1000 VAC, 10Khz, adjust C11, high frequency adjust, for a reading of 1000.0. Verify specifications at 1000 VAC, 30hz, 5Khz, and 20Khz.

4.8 Ohmmeter Calibration

Program: Function -K ohm
Range -.1
Input Terminal & Guard -shorted

A. With the input shorted with a low resistance termination adjust R80, 100 ohm zero for a reading of 00.00. Apply a precision 100 ohm resistor across the input terminals verify a reading of 100.00 ±12 digits.

B. Program Range -1
With a 1K ohm precision resistor across the input, verify a reading of 1.0000 ± 7 digits.

C. Program: Range -10
With a 10K ohm precision resistor across the input, verify a reading of 10.000 ± 7 digits.

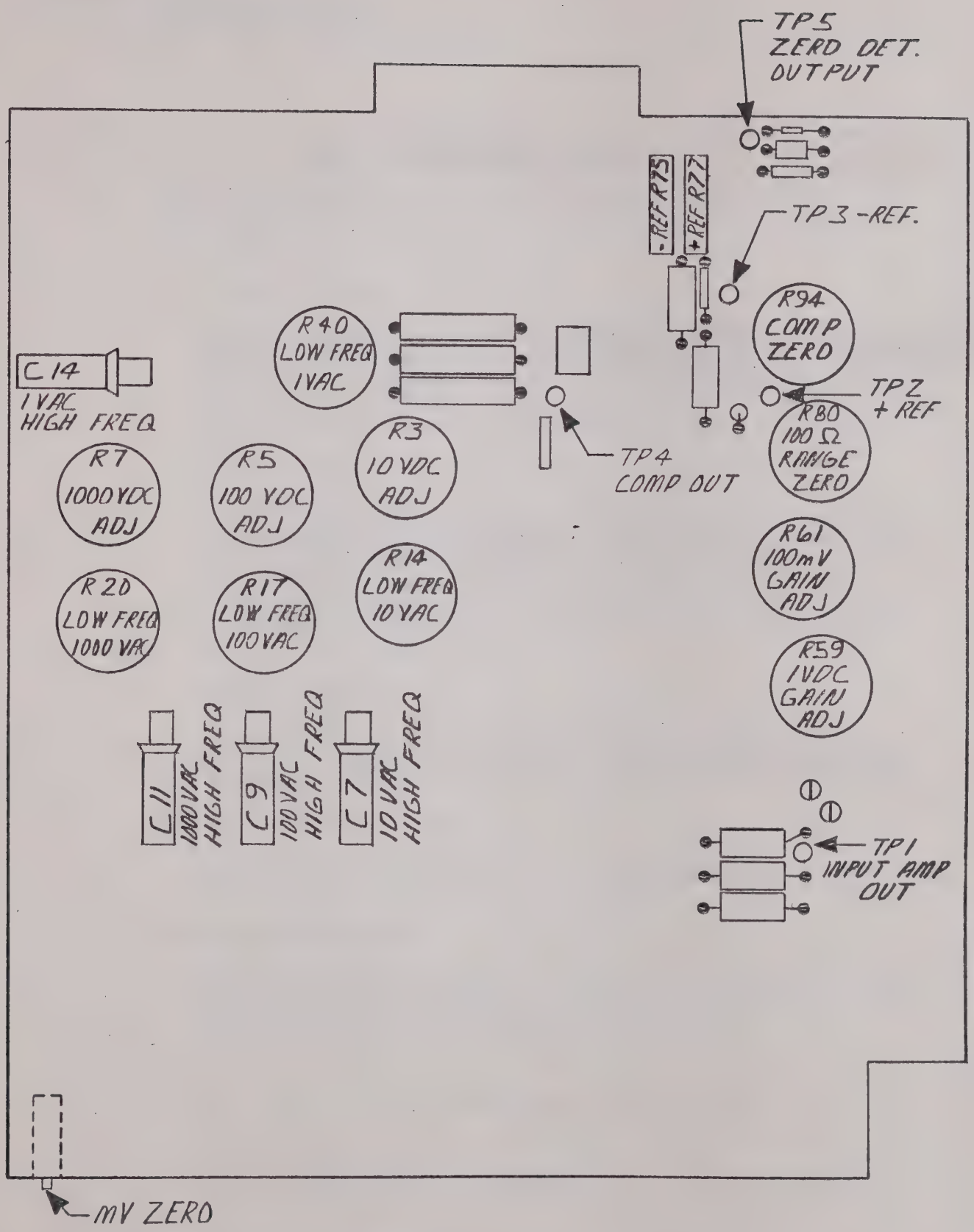
D. Program: Range -100
With a 10K ohm precision resistor across the input, verify a reading of 100.00 ± 7 digits.

E. Program: Range -1000
With a 1 megohm precision resistor across the input, verify a reading of 1,000.0 ± 7 digits.

F. Program: 10M
Note: Programming 10M should also depress the K ohm button. All range buttons must be out.
With a 10 Megohm precision resistor across the input, verify a reading of 10,00.00 ± 7 digits.

CAUTION:

Although protection is part of the ohmmeter section, use caution to avoid applying voltage while in this mode!


TP5
ZERO DET.
OUTPUT
-REF R75
+REF R77
TP3 -REF.
R94
COMP
ZERO
TP2
+ REF
R80
100 Ω
RANGE
ZERO
R40
LOW FREQ
1VAC
C14
1VAC
HIGH FREQ
R3
10 VDC
ADJ
TP4
COMP OUT
R7
1000VDC
ADJ
R5
100 VDC
ADJ
R61
100mV
GAIN
ADJ
R14
LOW FREQ
10 VAC
R20
LOW FREQ
1000 VAC
R17
LOW FREQ
100 VAC
R59
1VDC
GAIN
ADJ
C11
1000 VAC
HIGH FREQ
C9
100 VAC
HIGH FREQ
C7
10 VAC
HIGH FREQ
TP1
INPUT AMP
OUT
MV ZERO

DM 42A
FIG 4-1

SECTION V

LIST OF REPLACEABLE PARTS

5.1 The following section provides a list of replaceable parts for the DM 42A. This list is divided into five major sections:

A. Analog Assembly #338-105-80

This assembly includes all parts located on the Analog board and shown on the Analog schematic #338-105-(80). The Analog Assembly contains all components concerned with input circuitry, switching, integration, comparing, and filtering. For a component location, see Fig. 5-1.

B. Digital and Power Supply Assembly #338-104-80

This assembly includes all parts located on the digital board and most parts shown on schematic #338-314-(80). The Digital and Power Supply Assembly contains all components concerned with A/D conversion including counters storage, decoding, display and Print Option, plus power supplies for all systems. For component location see Fig. 5-2.

C. Print Output Option

Part of the Digital and Power Supply Assembly, this option is shown on Schematic #338-314-(80). Component location see Fig. 5-2.

D. Misscellaneous Parts

This section provides a listing of replaceable parts not included in other definite sections.

5.2 Ordering Information

When ordering replacement parts from the factory, please specify component number, description and PSC part number, to facilitate faster handling.

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SECTION V

DM 42A

REPLACEMENT PARTS LIST

Analog Assembly 338-105-80

COMPONENT NUMBER	DESCRIPTION	MANUFACTURER NUMBER	P.S.C. STOCK NUMBER
_____	P.C. Board	P.S.C.	338-105-30A
S1-3	Function Switch Assembly	Centralab PB15	95-64-053
S4-9	Range Switch Assembly	Centralab PB15	95-64-054
A1-4, 6	Operational Amplifier	TI SN72741P	94-90-212
A7	Operational Amplifier	TI SN72741L	94-
A5	Operational Amplifier	TI SN72709P	94-90-210
Q1	Field Effect Transistor	TI 2N3819	41-0005
Q2	Transistor	G.E. 2N3391	91-33-910
Q3-5	Transistor	G.E. 2N5175	91-51-750
Q6	Dual F.E.T.	National FM3955	94-90-216
Q8-10	Transistor	Motorola 2N3906	91-39-060
Q11-13	Transistor	Motorola 2N3904	91-39-040
Q14	Dual F.E.T.	National FM3958	94-90-215
CR1	Zener Diode	IRC 1N825	92-08-250
CR2	Zener Diode	TRW PS18196	94-16-055
D1, 2	Diodes	CDC 5645	
D, 6-12	Signal Diode	G.E. 1N914	92-09-140
D4, 5	Signal Diode	G.E. 1N916	92-09-160

Analog Assembly 338-105-80 (Cont'd.)

COMPONENT NUMBER	DESCRIPTION	MANUFACTURER NUMBER	P.S.C. STOCK NUMBER
R1	Resistor 1M, 1W, .1%	Airco Speer	83-44-961
R2	Resistor 1.11M, ½W, .1% W.W.	R.S.C. A25E	15-15-608
R3, 80, 94	Variable Res., 2K	CTS 110	88-15-271
R4	Resistor 100.91K, ½W, .1 W.W.	P.S.C. A25E	15-15-606
R6	Resistor 10K, ½W, .1% W.W.	P.S.C. A25E	15-15-604
R5, 61	Variable Resistor 200 ohms	C.T.S. 110	88-15-110
R7, 40, 59	Variable Resistor, 20 ohms	C.T.S. 110	88-15-075
R8, 12, 16,	Resistor 1M, ½W, 1%, M.F.	IRC RN70C	83-44-961
R9	Resistor 523K ¼W, 1% M.F.	IRC RN60D	83-20-816
R13, 22	Resistor, 121K, ¼W, 1% M.F.	IRC RN60D	83-43-796
R14	Variable Resistor, 5K	C.T.S. 110	88-15-348
R16	Resistor, 10K, ½W, 1%, M.F.	IRC RN70C	25-0004
R17	Variable Resistor 500 ohms	C.T.S. 110	88-15-211
R18	Resistor, 1M, 1W, 1% M.F.	IRC RN75C	83-75-961
R19	Resistor 1K, ½W 1%, M.F.	IRC RN70C	83-44-961
R20	Variable Resistor, 50 ohms	C.T.S. 110	88-15-085
R23	Resistor, 49.9K, ¼W, 1%, M.F.	IRC RN60D	83-20-659

Analog Assembly 338-105-80 (Cont'd.)

COMPONENT NUMBER	DESCRIPTION	MANUFACTURER NUMBER	P.S.C. STOCK NUMBER
R24	Resistor, 100K, ¼W, 5% F.C.		86-04-564
R25	Resistor, 60.4K, ¼W, 1%, M.F.	IRC RN60D	83-20-666
R26, 29	Resistor, 150K, ¼W, 5%, F.C.		86-04-580
R27, 55, 56 97, 98, 100	Resistor, 2.2K, ¼W, 5% F.C.		86-04-396
R28, 32, 33, 67, 91	Resistor, 680 ohms ¼W, 5% F.C.		86-04-348
R30, 54, 63, 84, 86, 88, 90	Resistor, 10K, ¼W, 5%, F.C.		86-04-464
R31	Resistor, 1.8K, ¼W, 5%, F.C.		86-04-388
R34	Resistor, 180K, ¼W, 5%, F.C.		86-04-588
R35	Resistor, 3.9K, ¼W, 5%, F.C.		86-04-424
R36	Resistor, 270K, ¼W, 5%, F.C.		86-04-608
R37, 41	Resistor, 100K, ¼W, 1%, M.F.	IRC RN60D	83-20-692
R38	Resistor, 20K, ¼W, 1%, M.F.	IRC RN60D	83-20-646
R39	Resistor, 1150 ohms, ¼W, 1%, M.F.	IRC RN60D	83-20-350
R42, 43, 78	Resistor, 2K, ½W, .05%, W.W.	P.S.C. A25E	15-15-429
R44, 46	Resistor, 20K, ½W, .05%, W. W.	P.S.C. A25E	15-15-450
R47	Resistor, 2.230K, ½W, .05%, W.W.	P.S.C. A25E	15-15-603

Analog Assembly 338-105-80 (Cont'd.)

COMPONENT NUMBER	DESCRIPTION	MANUFACTURER NUMBER	P.S.C. STOCK NUMBER
R48	Resistor, 203.02 ohms ½W, .05% W.W.	P.S.C. A25E	15-15-601
R50, 51, 93, 95	Resistor, 30.1K, ¼W, 1%, M.F.	IRC RN60D	83-20-649
R52	Resistor, 14K, ¼W, 1%, M.F.	IRC RN60D	83-20-619
R53	Resistor, 39K, ¼W, 5%, F.C.	_____	86-04-524
R57	Variable Resistor, 1K	Bourns 3009P	88-16-256
R58	Resistor, 10K ohm ½W, .05%, W.W.	P.S.C. A25E	15-15-604
R60	Resistor, 122.5K, ½W, .05%, W.W.	P.S.C. A25E	15-15-607
R62	Resistor, 2.5K, ½W .05%, W.W.	P.S.C. A25E	15-15-432
R64, 101, 106	Resistor, 4.7K ¼W, 5%, F.C.	_____	86-04-432
R65, 85, 87, 89, 102, 103	Resistor, 1K, ¼W, 5%, F.C.	_____	86-04-364
R66	Resistor, 511 ohms ¼W, 1%, M.F.	IRC RN60D	83-20-290
R68, 69, 71	Resistor, 2K, ½W, .05%, W.W.	P.S.C. A25E	15-15-429
R70	Resistor, 1.225K ½W, .05%, W.W.	P.S.C. A25E	15-15-602
R72, 76, 107	Resistor, 1M, ¼W 5%, F.C.	_____	86-04-664
R75, 77	Variable Resistor 100K	Bourns 3009P	88-16-386
R80	Variable Resistor 2K	C.T.S.	88-15-271

Analog Assembly 338-105-80 (Cont'd.)

COMPONENT NUMBER	DESCRIPTION	MANUFACTURER NUMBER	P.S.C. STOCK NUMBER
R81, 82, 83	Resistor, 5.6K, ¼W, 5%, F.C.		86-04-440
R96	Resistor, 37.4K, ¼W, 1%, M.F.	IRC RN60D	83-20-653
R101	Resistor, 22K, ¼W, 5% F.C.		86-04-496
R104, 105	Resistor, 100 ohms ¼W, 5% F.C.		86-04-264
C4, C46	Capacitor, Polystrene .047 mfd	Elpac	60-01-473
C5, 33	Capacitor, Polystrene .1mfd	Elpac	60-02-102
C7, 9, 11, 15	Variable Capacitor, .7 to 14 pf		65-00-006
C8, 34	Capacitor, Mica 33pf	Elmenco	53-01-330
C10	Capacitor, Mica 390pf	Elmenco	53-01-391
C12	Capacitor, Mica 3900pf	Elmenco	53-09-392
C13	Capacitor, Mica .5pf	Elmenco	53-00-020
C15, 16, 42, 43	Capacitor, Tant., 4.7 mfd	Kemet	64-21-475
C17	Capacitor Tant., 60mfd	Kemet	64-31-606
C18	Capacitor, Mica 100pf	Elmenco	53-01-101
C19	Capacitor, Mica 20pf	Elmenco	53-00-200
C20	Capacitor, Electrolytic 100mfd	Sprague 39D	61-04-107

Analog Assembly 338-105-80 (Cont'd.)

COMPONENT NUMBER	DESCRIPTION	MANUFACTURER NUMBER	P.S.C. STOCK NUMBER
C21, 22, 29, 30 31, 32, 36, 37, 38, 39, 42, 43	Capacitor, Ceramic .1mfd	Centralab	48-25-474
C23, 24, 25,26 41	Capacitor, Mylar, 1mfd	_____	55-02-016
C27, 28, 34, 35	Capacitor, Mica 68pf	Elmenco	53-02-680

Digital and Power Supply Assembly 338-104-80

COMPONENT NUMBER	DESCRIPTION	MANUFACTURER AND NUMBER	P.S.C. STOCK NUMBER
_____	P.C. Board	P.S.C.	338-104-31
_____	Overrange Assy.	P.S.C.	338-327-80
J1	Connector P.C.	Winchester 8BD-12-M	70-90-804
DS1, 2, 3	Neons	Signalite A261	75-05-802
RT1, 2, 3, 4	Neon Indicators	Burroughs B5853S	75-10-079
Z1, 3, 11	Integrated Circuit	National SN7474N	94-90-224
Z2, 4, 5, 10	Integrated Circuit	National SN7400N	94-90-217
Z6-9	Integrated Circuit	National SN7490N	94-90-223
Z12,15	Integrated Circuit	National SN7475N	94-90-222
Z16-19	Integrated Circuit	National SN7441N	94-90-221
Z20	Integrated Circuit	National SN1593N	94-90-220
Z21	Integrated Circuit	National SN7410N	94-90-218
Z22	Integrated Circuit	National SN7440N	94-90-219
A1	Voltage Regulator	National LM309	
Q6	Transistor	G.E. 2N3391	91-33-910
Q8	Transistor	Fairchild 2N4249	91-42-490
Q9	Transistor	Motorola 2N4918	91-49-180
Q10, 11, 12	Transistor	G.E. 2N5175	91-51-750
Q13	Transistor	Motorola 2N3904	91-39-040
Q14	Uni-junction Trans.	Motorola 2N4852	91-48-520
D22-29	Diode, Rectifier	IR 1N4005	40-0003
D11-20	Diode, Signal	G.E. 1N914	92-09-140
CR1, 2	Diode, Zener	1N965A	

Digital and Power Supply Assembly 338-104-80 (Cont'd.)

COMPONENT NUMBER	DESCRIPTION	MANUFACTURER AND NUMBER	P.S.C. STOCK NUMBER
C1	Capacitor, Electrolytic 1000mfd	Sprague 39D	40068
C2, 3	Capacitor, Electrolytic 200mfd	Sprague 39D	41369
C4, 5, 9,28	Capacitor, Ceramic, .05mfd	Centralab	48-10-503
C6, 7, 8, 34	Capacitor, Tant., 4.7mfd	Kemet	64-21-475
C8	Capacitor, Electro 20mfd	Sprague 39D	61-14-508
C10	Capacitor, Mica 390pfd	Elmenco	53-01-391
C11	Capacitor, Electro 10mfd	Sprague 39D	61-05-106
C12, 13	Capacitor, Mica 470pfd	Elmenco	53-09-471
C14	Capacitor, Ceramic .005mfd	Centralab	53-01-102
C15-29	Capacitor, Ceramic .001mfd	Centralab	48-16-102
R1	Resistor, .5 ohms ½W, .1%, W.W.	P.S.C. A25E	15-15-610
R3, 6, 11	Resistor, 2.2K, ¼W, 5% F.C.	_____	86-05-396
R4, 14, 17	Resistor, 4.7K ¼W, 5% F.C.	_____	86-05-432
R7, 12	Resistor, 4.7 ohms ½W, 5%, F.C.	_____	86-05-132
R8	Resistor, 8.87K ¼W, 1%, M.F.	IRC RN60D	83-20-581
R9, 10	Resistor, 4.7K ½W, 5%, F.C.	IRC RN60D	86-05-432

Digital and power Supply Assembly 338-104-80 (Cont'd.)

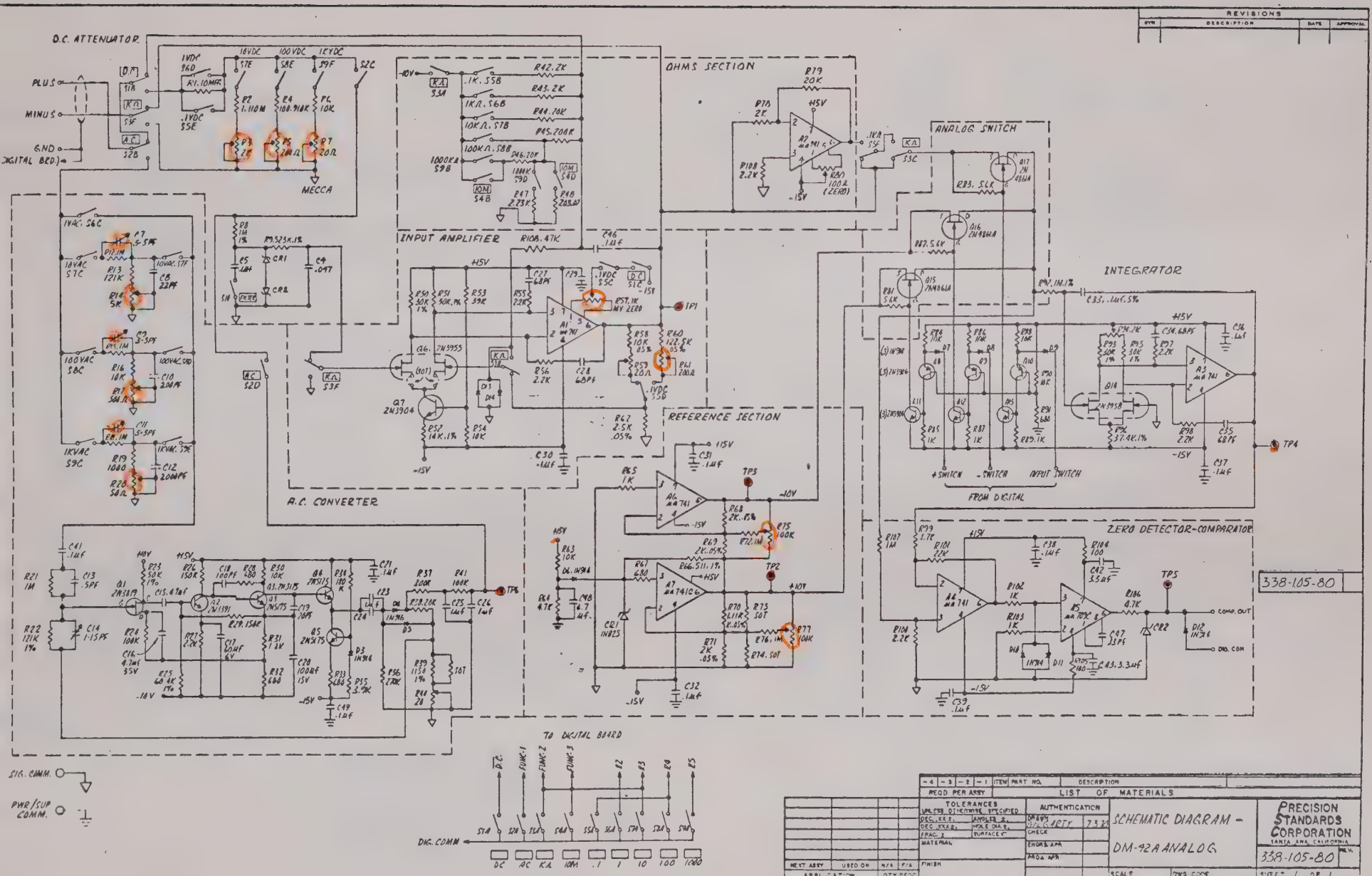
COMPONENT NUMBER	DESCRIPTION	MANUFACTURER AND NUMBER	P.S.C. STOCK NUMBER
R15, 30, 31	Resistor, 1K, ¼W 5%, F.C.		86-04-364
R16	Resistor, 51 ohms ¼W, 5%, F.C.		86-04-236
R19	Resistor, 100 ohms ¼W, 5%, F.C.		86-04-264
R20, 23	Resistor 10K ohms ¼W, 5%, F.C.		86-04-464
R24, 26	Resistor, 47K, ¼W, 5%, F.C.	-	86-04-532
R27, 29	Resistor, 3.9K ¼W, 5%, F.C.		86-04-424
R32	Resistor, 470 ohms ¼W, 5%, F.C.		86-04-332
R33-35	Resistor, 1M ohms ¼W, 5%, F.C.		86-04-664
R36-38	Resistor, 220 ohms ¼W, 5%, F.C.		86-04-296
R39	Resistor, 470 ohms ¼W, 5%, F.C.		86-05-332

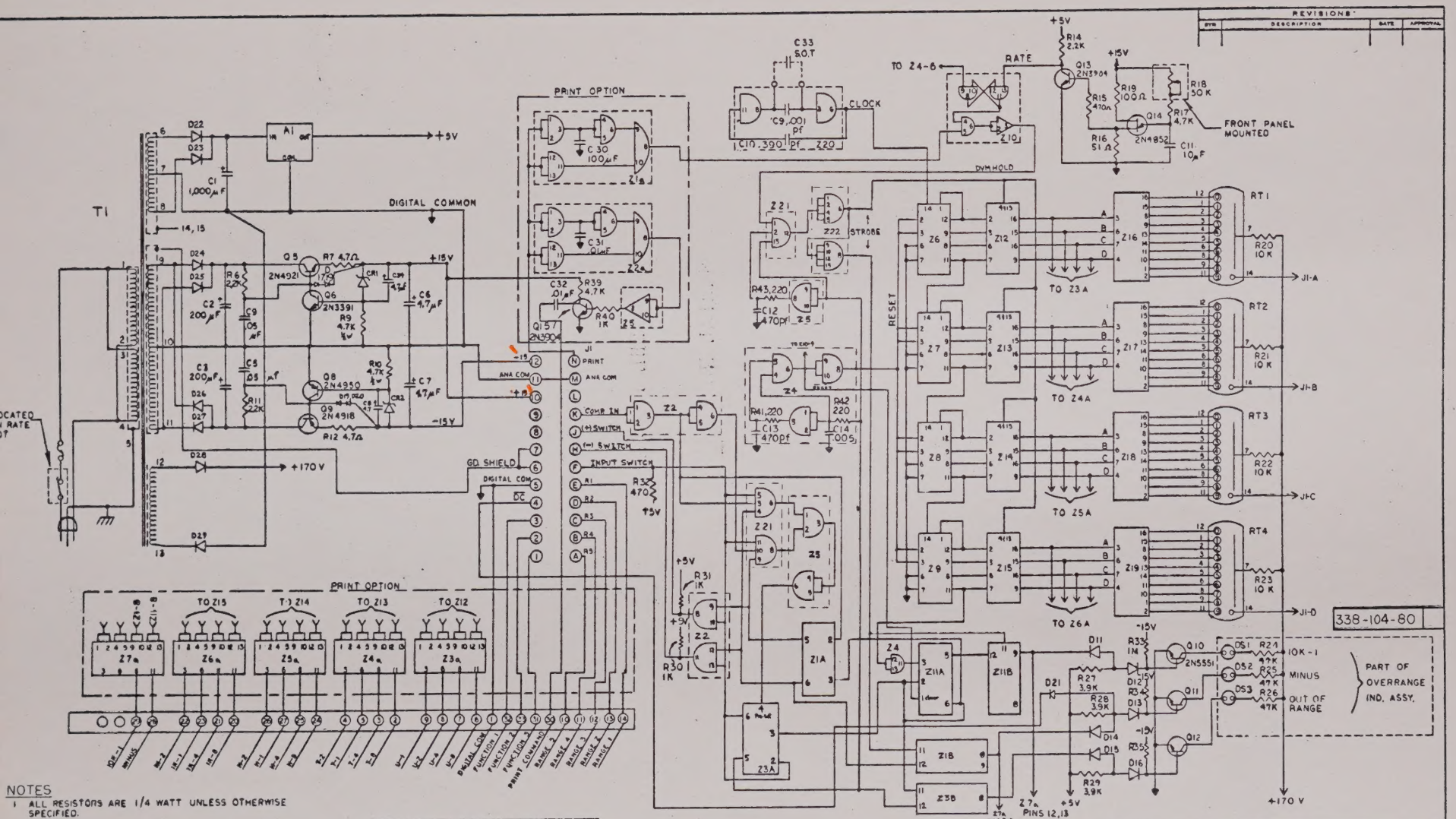
Print Option (Part of 338-314-80)

COMPONENT NUMBER	DESCRIPTION	MANUFACTURER AND NUMBER	P.S.C. STOCK NUMBER
Z1a, Z2a	Integrated Circuit	National SN15946N	94-90-225
Z3a-Z7a	Integrated Circuit	National SN7400N	94-90-217
Q1a	Transistor	Motorola 2N3904	91-39-090
R39	Resistor, 4.7K, ¼W, 5%, F.C.	_____	86-04-432
R40	Resistor, 1K, ¼w, 5%, F.C.	_____	86-04-364
C30	Capacitor, Electrolytic 100mfd	Sprague 39D	61-04-107
C31,32	Capacitor, Ceramic .01mfd	Centralab	48-30-103

Miscellaneous

COMPONENT NUMBER	DESCRIPTION	MANUFACTURER AND NUMBER	P.S.C. STOCK NUMBER
_____	Fuse Holder	_____	72-05-052
F1	Fuse 1A	Buss	72-01-035
_____	Handle	P.S.C.	338-312-30
_____	Hub	P.S.C.	338-310-30
_____	Knob	P.S.C.	338-311-30
_____	Bullet Catch	H.S. #11027-FW18	71-35-176
T1	Transformer	P.S.C.	96-43-724C
_____	Line Cord	_____	98-28-103
_____	Wave Washer	Assoc. Spring U375-0160	71-25-999
J2	Mating Print Conn.	Winchester 8BD18-D	70-90-805


REVISIONS
ZONE
DESCRIPTION
DATE
APPROVAL
D.C. ATTENUATOR
OHMS SECTION
ANALOG SWITCH
INPUT AMPLIFIER
INTEGRATOR
REFERENCE SECTION
A.C. CONVERTER
ZERO DETECTOR-COMPARATOR
TO DIGITAL BOARD
FROM DIGITAL
+SWITCH
-SWITCH
INPUT SWITCH
SIG. COMM.
PWR/SUP COMM.
DIG. COMM
338-105-80
SCHEMATIC DIAGRAM - DM-92A ANALOG
PRECISION STANDARDS CORPORATION
SANTA ANA, CALIFORNIA
LIST OF MATERIALS
DESCRIPTION
PART NO.
ITEM
REQD PER ASSY
TOLERANCES
AUTHENTICATION
SCALE
SIZE



NOTES

1 ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED.

QTY	DESIG.	TYPE	PIN VCC	PIN GND	FUNCTION
2	Z21	SN7410N	14	7	NAND GATES (3×3)
3	Z1,3,11	SN7474N	14	7	DUAL F-F
4	Z2,4,5,10	SN7400N	14	7	NAND GATES (4×2)
1	Z20	SN5832N	14	7	NOR GATES (2×5)
4	Z6-Z9	SN7490N	5	10	COUNTER
4	Z12-15	SN7475N	5	12	BISTABLE LATCH
4	Z16-19	SN7494N	5	12	DECODER/DRIVER
7	Z1A-Z7A	SN7400N	14	7	NAND GATES (4×2)
1	Z23	SN7420N	14	7	NAND GATES (2×4)

+5 Vcc
C15-29 4700μF

ITEM	PART NO.	DESCRIPTION	REQD PER ASSY
-4			
-3			
-2			
-1			

LIST OF MATERIALS

TOLERANCES UNLESS OTHERWISE SPECIFIED
DEC. XX ±
DEC. XXX ±
FRAC. ±
MATERIAL
FINISH

AUTHENTICATION
DRAWN
CHECK
ENGR APP. T.C. BARDIN
PROJ APP.

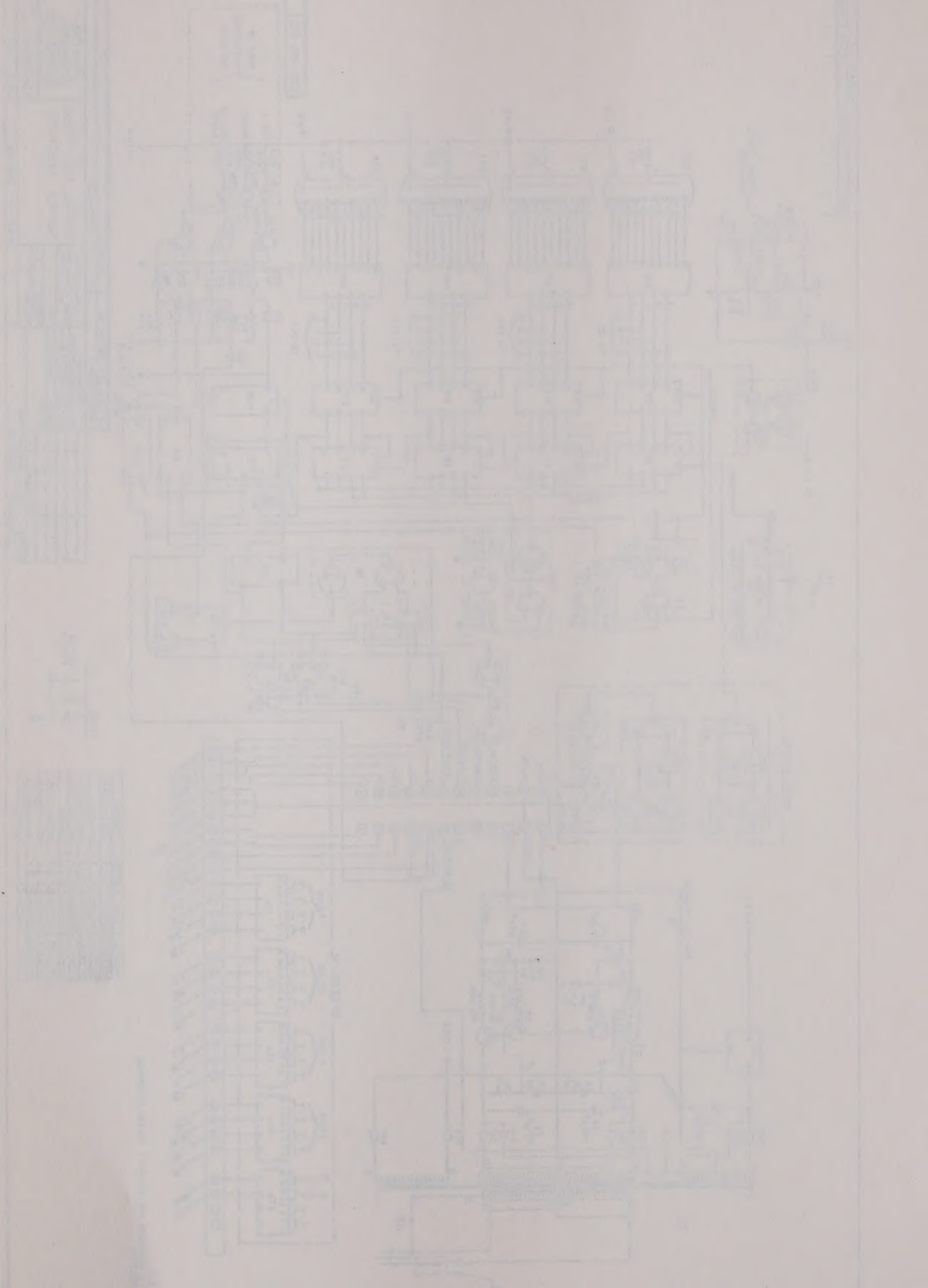
DIGITAL AND POWER SUPPLY SCHEMATIC

PRECISION STANDARDS CORPORATION
SANTA ANA, CALIFORNIA

338-104-80 REV.

SCALE — DWG CODE — SHEET 1 OF 1

NEXT ASSY OM-42A
USED ON N/A F/A
APPLICATION QTY/REQD



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